POCKET SERIES NO. 419
Edited by E. Haldeman-Julius

Life: Its Origin and Nature

HEREWARD CARRINGTON, Ph. D.

HALDEMAN-JULIUS COMPANY
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Author of "The Coming Science," "The Natural Food of Man," "Vitality, Fasting and Nutrition," Etc.

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THE EVOLUTION OF MATTER

One of the greatest achievements of the mind of man is assuredly its ability to ascertain with almost mathematical exactitude the chemical composition of stars (or suns) many millions of miles distant from us in space. No human being has ever left the surface of our earth, to explore these heavenly bodies so distant from us in space that it takes tens of thousands of years for their light to reach us, traveling at the rate of 186,000 miles a second, nor will man ever be enabled to do so during his physical life. The light which left the surface of one of these heavenly bodies may reach us years after the body itself has "exploded" or gone out of existence; but it would *appear* to us still to be resident in space. By means of a tiny pencil of light, it is possible to ascertain the precise chemical constituents of any distant star, by means of spectrum analysis. Certain dark lines which appear at specific intervals on the light spectrum (after the latter has been broken up into its seven primary colors, by passing it through a prism) tell us the nature of the chemical elements constituting that star. Each chemical element is represented by a particular arrangement of the dark lines, and no two elements are alike in this peculiarity. Any incandescent body, composed of various chemical elements is, therefore, represented by the varied groupings of the lines thrown on the screen; and by studying these lines, the chemical ele-

ence so far as its physical manifestation is concerned. The period, however, between these two extremes is of course represented by many hundreds of millions of years.

Newer researches have also proved that all matter, organic and inorganic, is composed of the *same* chemical elements, and that these elements, in turn, are composed of atoms, which are in turn constituted of electrons. Each atom represents a miniature solar system, in which the negative "electrons" revolve in special orbits about the central "protons," or positive electric charges. An *electrical theory of matter* has thus been deduced, which is applicable alike to living and non-living bodies. Living bodies are merely complex groups of molecules which, in turn, are combinations of atoms, which in turn are composed of electrons, etc. On this view, there is and can be no difference, ultimately, between living and so-called "dead" matter. Nevertheless, there *is* a great difference, for living matter embodies or expresses *life*, while dead matter does not. What is this "life?" What is the nature of the difference between living and non-living matter? That is one of the most fundamental and interesting problems of modern science, and the remainder of this little book will be devoted to an attempt to answer this question, as well as to portray some of the manifestations or evidences of this hidden and invisible life principle or energy.

THE ORIGIN OF LIFE

From the foregoing discussion, it is evident that life, as we understand it, could not have existed from the very beginning of things on our planet. It must have come into being somehow or other at one time in the past, and it is equally certain that, at some distant date in the future, it will go out of existence when the conditions on our planet no longer permit the existence of life upon its surface. Life can only exist between very narrow temperature-limits, and under a complex set or very particular circumstances. The temperature-limits which permit physical life are *the freezing and the boiling points of water*. If the temperature permanently falls below or rises above these limits, life can no longer exist, and immediately passes out of being. As a matter of fact, for all practical purposes, the temperature limits are even narrower than this—being limited to about 100 degrees—above and below which life finds it extremely difficult to exist. In addition to which the suitable environment must also be present—suitable atmospheric conditions, sufficient oxygen, sunlight, the right chemical elements, etc.

During the many millions of years which must necessarily have elapsed between the time when our planet was a more or less incandescent body, and the time when it will have become a dead and frozen mass of matter whirling through space, a *relatively* brief period of time elapses, in the process of cooling, during which life can become manifest. It has therefore been

said that, cosmically speaking, life is a mere "flash in the pan," between two eternities, yet *for us* it is this "flash in the pan" which is everything.

The question of the origin of life upon our planet is naturally of great interest, and is one which has been discussed at greater length than almost any other scientific problem. Various theories have been advanced in the past, ranging from the purely theological conception that life was imparted directly by some external Deity, as a special "act of creation," to the materialistic view that life must somehow have come into being as the result of some process of spontaneous generation. A few of these theories I shall endeavor to summarize very briefly.

The theory of spontaneous generation has not as yet received scientific support, and no proof exists that it ever occurs under the present circumstances. Until the time of Pasteur, it was generally believed that it was more or less a common phenomenon, but Pasteur proved that the experiments which had been conducted in the past were inconclusive, and that no scientific evidence existed tending to show that spontaneous generation ever exists, as a matter of fact. Doctor Charlton Bastian, of England, conducted a number of experiments in an endeavor to prove that spontaneous generation could be brought about experimentally in the laboratory, and published a number of books, endeavoring to demonstrate this. Among these may be mentioned "The Beginnings of Life," in two volumes; "The Origin of the Lowest Organ-

isms," "The Nature and Origin of Living Matter," "The Origin of Life," and "The Evolution of Life." Experimental defects were proved to exist, however, in the majority of his experiments, and it is true that his work has not so far succeeded in convincing the scientific world. One fundamental difficulty which always presents itself is this—all life as we know it is the product not only of certain chemical and physical forces, but also of *heredity*, and, on the theory of spontaneous generation, we must assume that the first living organisms somehow sprang into being without any hereditary characteristics at all. This is an enormous theoretical difficulty which has never been surmounted. Nevertheless, if experimental *proof* were ever offered, this objection would have to give way to the facts.

Doctor J. Butler Burke, of Cambridge, England, some years ago published a book entitled "The Origin of Life," in which he advanced the claim that he had been successful in producing a form of artificial life in test-tubes by means of radium and sterilizied bouillon. He called the resultant products RADIOBES. It was soon shown, however, that these radiobes did not multiply, and in fact showed almost none of the true signs of life. It was therefore concluded that he had not succeeded in creating life, but only life like bodies, which had a few of the outward manifestations of life.

Another experimentalist who stoutly maintained the theoretical possibility of spontaneous generation was Prof. Felix Le Dantec, of the University of Paris. In his book "The Nature

and Origin of Life," he attempted to show that living and non-living matter were by no means fundamentally different in their characteristics; that they shaded into one another by degrees, and that many of the characteristics of life had been artificially demonstrated to exist in non-living bodies which had been "created" by purely chemical methods. This contention—that there existed no essential difference between living and non-living matter—seemed to be borne-out by the ingenious researches of Prof. Chunder Bose, of the University of Calcutta, who showed that all substances manifest at least some of the phenomena of life, and that even metals are subject to fatigue, and need rest. Again it has been shown that some chemical substances (for example, linseed oil) seem to possess a certain degree of *memory;* that the speed of its reaction to other substances increases from day to day, but that if a few days are allowed to intervene between the experiments, a longer time elapses before the reaction takes place, seeming to show that the linseed oil has, so to say, forgotten how to react in an appropriate manner.

In spite of these many similarities, however, it is nevertheless true that great differences also exist between living and non-living substances. For example, it has been contended that many of the characteristics of life are manifested by crystals, but Doctor McKendrick (in his "Principles of Physiology") has pointed out that genuine living matter *never* assumes a crystal-like formation; and there is this further distinction, that, whereas crystals grow

by "accretion," or adding material to their own structure from the substance in which they are immersed, living substances grow by converting other substances into themselves by some process of "digestion." Furthermore, crystals do not propagate, or reproduce themselves, in the true sense of the word. For these and other reasons, therefore, the idea that crystals are in any way analogous to living beings, has been largely given-up.

Theoretically, some kind of spontaneous generation, at one time or another in the world's history, *must* have taken place, in order for life to become manifest at all; and yet science can find no proof of its occurring today. It has been suggested that, under differing chemical, thermal and atmospheric conditions—which may have existed upon this planet millions of years ago—but which are today non-existent, some form of spontaneous generation may have been possible. However, it seems plausible to assume that any artificial conditions of the kind should be capable of being reproduced in the laboratory today. Yet, as before stated, no adequate experimental proof exists that spontaneous generation ever takes place, in the true sense of the word. Since life seemingly could not have been spontaneously produced upon our planet, therefore, other theories were advanced in an attempt to account for its presence.

There is the theory, for example, first advanced by a French writer, Count Salles-Guyon, and defended by F. Cohn, H. Richter, Helmholtz and Lord Kelvin (being, in fact, made known

to the English-speaking world by the last-mentioned scientist, and the idea commonly credited to him, though this is a mistake) that life never had any "beginning" *on our planet.*

"It was transported to the earth from another world, or from the cosmic environment, under the form of cosmic germs, or cosmozoans, more or less comparable to the living cells with which we are acquainted. They have made the journey either included in meteorites or floating in space in the form of cosmic dust."

But M. Verworn considers the hypothesis of cosmic germs as inconsistent with the laws of evolution, and L. Errera pointed out that the necessary conditions for life were lacking in interplanetary bodies.

Dubois-Reymond's theory of *cosmic panspermia* is one very similar to the above, and needs no separate statement of its position. The same objection applies to both, viz., that it is really no "explanation" at all, since it merely pushes back our inquiry one step, and, if we were to ask: "What was the origin of the life on the planet or in the space from which such germs came, supposedly, we should obviously be in as great a quandary as ever. So superficial a hypothesis is not only not explanatory, but absurd. Realizing such objection, W. Preyer was forced to admit that "Life . . . must have subsisted from all time, even when the globe was an incandescent mass." This position—apart from its inherent absurdity—practically admits that life was and is as eternal and persistent as matter and energy; and this is the position which scientists will, I think, some day be forced to admit.

Doctor Benjamin Moore, in his work on the "Origin and Nature of Life," has pointed out that "the spontaneous production of any such a thing as a bacterium or other unicellular organism, would by no means solve the problem, since the new-born cell would have no organic pabulum, and must perish (in a world in which there is yet no life). The production of anything so complex as chlorophyll at such a stage is unthinkable to anyone acquainted with the subtle continuity of all nature. In such a world, inorganic colloids must first develop, and in time one of these must begin to evolve, not a living cell, not anything so complex as a micrococcus, or a bacillus, not even a complex protein, carbohydrate, or fat, but some quite simple form of organic molecule, holding a higher store of chemical energy than the simple inorganic bodies from which it was formed. To carry out such a function, the inorganic colloid must posses the property of transforming sunlight or some other form of radiant energy into chemical energy. Later, such simple organic compounds, by the agency of the same, or some other colloid, and with a supply of external energy, would begin to condense and form more complex organic molecules, and finally complexes of inorganic and organic matter would come into existence as crystallo-colloids. In this way, without any hiatus, life would be led-up-to and inaugurated."

This view is somewhat different than that maintained by Doctor Henry Fairfield Osborn, who, in his work, "The Origin and Evolution of Life," advances the following theory:

"In their power of finding energy or food in a lifeless world, the bacteria known as prototrophic or 'primitive feeders,' are not only the simplest known organisms, but it is probable that that represent the survival of a primordial stage of life chemistry. These bacteria derive both their energy and their nutrition directly from inorganic chemical compounds: such types were thus capable of living and flourishing on the lifeless earth even before the advent of continuous sunshine, and long before the first chlorophyllic stage (algæ) of the evolution of plant life. Among such bacteria, possibly surviving from archæozoic time, is one of these 'primitive feeders,' namely, the *nitroso monas* of Europe. For combustion, it takes in oxygen directly through the intermediate action of iron, phosphorus, or manganese, each of the single cells being a powerful little chemical laboratory which contains oxidizing catalyzers, the activity of which is accelerated by the presence of iron and manganese. Still in the primordial stage, *nitroso monas* lives on ammonium sulphate, taking its energy (food) from the nitrogen of ammonium, and forming nitrites. Living symbiotically with it is *nitro bacter*, which takes its energy (food) from the nitrites formed by *nitroso monas*, oxidizing them into nitrates. Thus these two species illustrate in its simplest form our law of the interaction of an organism with its life environment."

By way of analogy, it has of course been pointed out that plants derive their nutriment directly from inorganic substances, and con-

vert them into the living plant. Animals do not and cannot subsist *directly* upon inorganic substances. They must derive them *indirectly* either through plants or the tissues of other animals, which in turn have fed upon plants. In this way, inorganic substances are supplied to the body, but animals cannot *directly* appropriate inorganic substances of any kind. Plants do so, and we seem to have here a case in which inorganic matter is converted into living substance, and in a certain sense, therefore, life produced from not-life. There is, however, this point: that the vegetable or plant merely feeds in this manner, and is in no way originally *generated* by the food of which it partakes. The plant originated from another plant, so that the laws of heredity apply to it directly, as before pointed out, and it is not, strictly speaking, an example of spontaneous generation at all.

The life of any *individual* only begins, of course, in the union of the sexual elements derived from the parents, and the above discussion has been limited to the *ultimate* origin of life upon our planet. Further, it is now known that many unicellular organisms do not multifly by sexual conjugation at all. They multiply by "fission," a mother-cell splits into two daughter cells, which, when they have grown to the normal size, again divide,—and so on forever. There is never any normal death among these lower orders of being, and there has never been any sexual conjugation to initiate them. The problem therefore remains as to their origin, together with the problem of

the origin of all other living matter; and it may be said that this problem remains today unsolved, and remains one of the most baffling problems of modern science. Once life has begun, its gradual evolution into more and more complex and highly developed forms is conceivable, but the question of its ultimate origin remains today still shrouded in mystery.

THE EVOLUTION OF LIFE

Ever since the time of Charles Darwin, the concept of evolution has been more or less a commonplace in the minds of thinking men. We know that higher forms of life have gradually evolved from more lowly and simpler forms. The *fact* of evolution, however, does not necessitate any particular *theory* as to *how* evolution *works*. The particular theory of evolution propounded by Darwin has now been supplemented or changed by newer researches, but the causes of evolution are to a great extent as mysterious as ever. Lamarck, Darwin, Weisman, and others, have propounded theories of their own, based on the principle of slow progress, involving no essential "break,"—whereas De Vries, as we know, in his theory of mutation, has advanced the idea that a series of sudden or abrupt changes is quite possible, and is, in fact, to be observed today in many cases of plants and, to a lesser extent, even in the lower forms of animal life.

However evolution may be thought to operate, the fact of evolution is certain. As a matter of fact, there are various evolutions

which are at work all at once. Osborn has contended that there are *four* evolutions proceeding simultaneously, which are somehow adjusted to one another. He says:-

"In the process of the origin and early evolution of life, complexes of four greater and lesser energy-groups arise, namely: *Inorganic environment*,—the energy content in the sun, the earth, the water, and the air; *organisms*:—the energy of the individual, developing and changing the cells and tissues of the body, including that part of the germ which enters every cell; *heredity-germ*:—the energies of the heredity-substance (heredity-chromatin) concentrated in the reproductive cells of continuous and successive generations, as well as in the cells and tissues of the organism; and *life environment*:—beginning with the monads and algae and ascending in a developing scale of plants and animals."

Evolution assures us that the *quality* of life is constantly improving. Is the *quantity* of life commensurately increasing? We know that it must be, in view of the fact that the number of living creatures upon the earth is continually increasing, as they multiply by reproduction. Life, both in quantity and quality, is, therefore continually expanding. This fact gives rise to a very significant thought. Although the law of the Conservation of Energy is probably true, it is also true that all modes of energy are not of equal value; some of them are higher than others, and the lower cannot readily be converted into the higher, although the higher give rise to the lower. There is, therefore, a law

of the "degradation of energy," as there is a law of its conservation. Dr. Gustav Le Bon has gone so far as to assert (in his "Evolution of Forces") that all energy is ultimately being resolved into heat, which is being radiated into space, and thus ultimately lost, for all practical purposes.

Now *life*, as we know it, is one of the highest and most complex forms of energy known to us,—and this, as we have seen, is constantly being infused into the world as the population increases,—and hence a constant addition is being made to the highest form of energy known to us. From this it would appear that an effort is being made to replenish energy, as it is being dissipated or lost, so that the total amount of energy is constantly preserved, as new life is infused. This significant fact has not, so far as I am aware, been emphasized in the past; but, if true, it is assuredly a truth of no little significance. The tendency of evolution is, therefore, to increase and improve life in all its forms. What is the object of this? To what purpose? The answer to this question will be briefly discussed in the chapter devoted to "Life's Meaning and Destiny."

THE PHYSICAL BASIS OF LIFE

Whatever theory we may hold as to the nature of life, it is certainly true that it manifests *through* a physical body, in this physical universe in which we live. Whether life originates within that body, and is merely the product of its functional activities,—or whether it is some principle which manifests through it,—

is a question for future research to decide. The fact remains, however, that life manifests through such a body, and that this body is the product of evolution and heredity on one hand, and of a combination of elements, on the other, —which elements are constantly being replaced, as the various tissues and organs of the body are repaired and replaced by the food material eaten.

The matter of which our bodies are composed must be the *same* matter, in its ultimate analysis, as all other matter in the universe. It has been contended e. g. that life originated in the sea, or at least in shallow pools which had been left after the sea had receded to a certain extent,—leaving the water more or less stagnant. It is a significant fact, in this connection, that precisely the *same* chemical elements are contained in living human beings as are contained in sea-water. These elements are: sodium, calcium, magnesium, potassium, chlorine, sulphur, carbon, hydrogen, oxygen and iron. The composition of the air is nitrogen, oxygen and carbon. The elements contained in living matter are these identical things! It has been suggested that, at the time when life was supposed to have originated upon our planet, the air was more or less saturated with carbon, and that this element, one of those essential for all life,—was largely instrumental in rendering possible the original "creation" of living matter.

A great deal of work has been done, of late years, in the field of organic chemistry—that is to say, the chemistry of living plants and an-

imals. While it is true that the body-substance of all living things is composed of the chemical elements known to us, it is also true that these chemical elements are combined together in extremely complex forms—far more complex than anything else known to us. To take one example: the haemoglobin of blood. A molecule of haemoglobin must contain the following number of different atoms in their due proportions, viz., of hydrogen atoms, 1,130; of carbon atoms, 712; of nitrogen, 214; of oxygen, 245; of sulphur, 2 and of iron, 1, or 2,304 atoms in all. Moreover, if that one atom of iron, in its peculiar relation to the rest ("masked," as some physiologists say) were left out, the animal could neither absorb oxygen nor give off carbonic acid,—in other words, it could not breathe. How such a combination of atoms could have been brought together by mere chance is in itself an extraordinary phenomenon, which needs considerable explanation!

The various chemical elements are combined organically into more and more complex groups, and as this process of building-up simple into complex substances proceeds, energy tends to become "latent,"—which energy is, in turn, liberated when these complex substances are later on broken-down into their more simple constituents. The latent energy is then liberated and converted into active or "kinetic" energy.

The human body is composed of a variety of substances, all more or less complex in character, of which *protoplasm* is the representative and typical example. But protoplasm itself

is a highly complex substance, and is, in turn, built up of a number of complex compounds. Recent researches have shown that life depends upon the presence of basic "colloids" as they are called,—known as colloidal substances or solutions. Colloids are gummy, semi-fluidic substances, which may be either organic or inorganic in nature. A typical example of the latter would be gum arabic. A c ystalloid, on the other hand, would be exemplified by a solution of common salt.

Colloids show two distinct forms of molecular arrangement, known respectively as "hydrosols" and "hydrogels." Thus a solution of glue or gelatine at such a temperature that it is fluid and mobile is a *hydrosol;* at a lower (or higher) temperature it sets into a solid jelly, and is then a *hydrogel*.. The white of an egg (uncooked) would be a good example of an organic hydrosol. When it is cooked, however, it is converted into a hydrogel.

The living body, as we know, is built up of proteins, fats, carbohydrates, water, and minute traces of various "salts," in organized form. These various substances are supplied to the body in the form of *food*, are constantly being converted into bodily substances by the various processes of digestion. Carbohydrates are converted into fats; glycerine and soaps are formed in the body; various amino-acids are formed, new proteins are developed, and in fact the substances which we eat are converted and reconverted, in the body, into a number of subsubstances, before they are finally utilized. A great deal of work has been done in the past,

in attempts to discover the precise nature of these various transformations; but the discussion of these detailed chemical questions would take us too far afield. The interested reader may be referred to such books as Prof. Chittenden's "The Nutrition of Man," and F. Czapek's "Chemical Phenomena of Life."

The mechanistic view of life is merely that physico-chemical reactions are alone sufficient to account for the life of the cell, and that the life of the organism is composed, as it were, of the totality of these cell-lives. It is difficult to see, however, how such a unifying of cell-lives could take place, unless there were some unifying principle or force, uniting these many lives into *one*—some "key-stone of the arch" which bound them together into a single living organism, such as we know it. This difficulty is still further exemplified by death, for here the lives of the individual cells continue for some time, and yet we say that such a person is "dead." It appears, at such times, as though the central, unifying principle had departed, leaving the cells of the body to die individually, in their own good time. We have discussed this question more fully, however, in the volume in this series devoted to the problem of "Death."

The body which we inhabit is intricate and beautiful almost beyond imagination. The complexity of its constituents, the marvelous interplay of its organs and functional activities, the beauty of its regulating mechanisms, the intricacy of its nervous system, the miracles of digestion, the subtlety of our sense organs, the

totally unexplained phenomenon of consciousness—all inspire us with wonder and awe, and make us realize the countless thousands of generations which must have existed in order to render possible such a perfected piece of mechanism, by the processes of gradual evolution.

THE MANIFESTATIONS OF LIFE

One of the most characteristic functions of life is its incessant tendency to express itself and to reproduce itself. Anyone who has sat on a grassy bank in the early spring, and has watched the young blades of grass shoot up from the soil, cannot but have been struck by the constant *urge* on the part of life thus to express itself, whenever the conditions of life were such as to render its manifestation possible. From apparently barren soil, from between clefts in a rock, plant life emerges. Thousands of insects and tiny animals are found everywhere, and over the whole surface of the earth swarm millions of invisible bacteria. Why should there be this persistent effort on the part of nature? To what end? This is a question which we will discuss in the chapter dealing with life's meaning and destiny. For the present, I wish merely to emphasize the constant activity and the constant desire for growth and reproduction by life of every variety.

Life is active; it is *dynamic*. It is not a static thing; it moves. And this movement is one of the characteristics of life. We are accustomed to think of "dead" matter as that which does not move of itself, but is only

displaced by some external energy outside itself. Whenever matter moves, we are accustomed to think of it as alive. This habit of mind has, of course, sprung from a very primitive belief that "spirits" were behind all the phenomena of nature, and that whatever happened was due to the intelligent action of these spirits. We still have traces of these primitive ideas, and we sometimes endow with a certain degree of personality dead matter, which does not appear to behave as we think it should. Thus, we frequently swear at and kick a chair or a cushion over which we have stumbled, as though it were an intelligent being; and a horse will shy at a piece of paper blown along the road. These animistic actions show us the primitive origin of our belief that living matter—and living matter only—is that which moves by reason of some internal and mysterious energy which actuates it from within.

These manifestations of life are very marked in the living, human body. Its internal functions and activities are all dynamic. Muscular activity of all kinds is, of course, an active manifestation of life-energy. Even the processes of thought involve the idea of movement; and we know that Bergson has emphasized the idea that life is a constant "flow" and an incessant activity. Huxley has also compared life to a swirling and flowing river.

These periods of active expression alternate, however, with periods of relative quiet, during which the activities of life are not outwardly manifest. Thus, during sleep, when the body

is in some way recharged by energy—fitting it for the next day's work—outward manifestations of life are lacking; but even here, certain internal mechanisms of the body (respiration, digestion, circulation, etc.) are active, but at a lower level. Muscular activity does not, curiously enough, wear out the parts utilized, but, on the contrary, strengthens and invigorates them. The more energy we expend in this way (within certain limits) the more we receive. Life and love are thus to some extent analogous; for, in the latter case also, "the more freely we give the more freely do we receive."

Up to a certain point, the activities of life are healthful; beyond that point, they become destructive. This is very obvious to us in the case of muscular activities. When muscles are exercised, a greater volume of blood is determined to these parts, which are thus fed, while impurities are carried away into the general blood-stream. When *fatigue* has once begun to supervene, however, these impurities begin to collect at a faster rate than they can be eliminated. A fatigued muscle is a poisoned muscle. It has been shown that a muscle may be washed-out, by means of salt water, and the fatigue removed, so that the muscle is as vigorous as ever. There are, however, two kinds of fatigue: (1) purely muscular fatigue, and (2) nervous exhaustion, which results from the depletion of the nervous energies in the nerve-cells or centres.

The most obvious of these manifestations of life is, of course, muscular activity, for here

physical movement is involved, which can readily be perceived by other individuals. Life, however, may be intensely active, without any visible expression of such activity. For example, a person may sit still in a chair, and think intently. Great activity may be going on within the brain. But this is totally invisible to a bystander. Life itself is always invisible, and we merely infer its presence by reason of certain physical activities, which are visible or manifest to us. But this is by no means a just criterion. A man may be paralyzed, and yet intently alive within himself. He merely lacks the means for physical expression, in the material world, of this life-activity. Thought and emotion also represent active manifestations of life, but they are invisible, or hidden.

One of the most characteristic factors of life is its desire to perpetuate itself. The stream of life must be perpetuated, even if the individual perishes! This is seen in many of the lower organisms which perish at the very moment that active reproduction has been accomplished. Among the manifestations of life, we must therefore include this remarkable desire to perpetuate and to reproduce itself. Next to self-preservation, it is the most powerful force in animate nature.

THE REGULATORS OF LIFE

The life of the body is not a blind force. It acts toward certain "ends." When actions are performed in the body, they are for a specific purpose. In this sense, all life is "teleological;" it acts towards a specific end and with a

specific purpose. Modern science, however, does not believe that these teleological actions involve any theological interpretation. They represent, merely, the purposeful manifestations of life, which are beneficial to the organism, and, if it were not for these, the living body would soon die, and the race would become extinct. There is some mechanism (or mechanisms) within the body, therefore, which regulates its activities, and causes every cell and tissue to perform its proper functions. What is the nature of this mechanism?

Briefly, there are *two* such mechanisms within the body, which control its functions and activities. These are (1) the ductless glands, and (2) the nervous system.

(1) Our knowledge concerning the functions of the ductless glands is relatively new. Within the past few years, it has been ascertained that there are, within the body, various ductless glands, of which the principal ones are the following: (a) The *thyroid* gland. This gland secretes a substance called "thyroxin," which controls, to a large extent, the growth of specialized organs and tissues—especially those of brain and sex. It is also the gland of energy-production. (b) The *pituitary* gland. This is divided into two parts, (1) the anterior, and (2) the posterior. The anterior portion secretes a substance known as "tethalin," which controls the growth of the skeleton and its supporting tissues. The posterior portion of the gland secretes a substance known as "pituitrin," which seems to control the growth and functional activity of the nerve and involuntary

muscle cells, and affects the brain and sex tone. (c) The *adrenals*. These are the glands of combat, and are stimulated whenever the fighting instinct is brought into play. The adrenals are subdivided into two portions, (1) the "cortex," secreting a substance as yet unknown, but which seems to affect the growth of the brain and the sex glands. (2) The "medulla," secreting "adrenalin," which substance imparts to the body energy for emergency situations. (d) The *pineal* gland. The precise nature of its secretion is unknown, but it seems to control the development of pubity, and affect brain and sex development. (e) The *thymus* gland. This is the gland of childhood; the nature of its secretion is as yet unknown. It seems to prevent too rapid maturity, and gradually disappears after pubity. (f) The *gonads*, or sexual glands. These, apart from their obvious functions, seem to govern the excitability of muscle and nerve, and also to control, to a great extent, the lime metabolism in the body. (g) The *pancreas*. This gland secretes a substance known as "insuline," and controls the sugar metabolism of the body.

It has been contended by certain authors (*e. g.*, Dr. Louis Berman, in his book "The Glands Regulating Personality") that the ductless glands, in addition to these purely physiological functions, also control, to a great extent, the character of the mental or psychic life; and that one's temperament, moods, emotions, and even the very personality itself is to a large extent governed and controlled by the activities and secretions of these glands. There

is doubtless some truth in these views, but it is probable that such a theory is an extreme view of the case, and that such a theory must necessarily be modified by later research. This interpretation is, of course, in line with a purely mechanistic conception of life, and will either stand or fall with it.

The other controller, or regulatng mechanism, of the human body is the *nervous system*, our knowledge of which is much older. It may roughly be divided into various sub-divisions. There are: (a) the "cerebrum," or brain proper, which is the recipient of our sense impressions, the originator of many conscious motor impulses, and the seat, apparently, of association and consciousness. Behind and below this complicated organ, there is the "cerebellum," which is a regulating mechanism, and serves to coördinate our movements. Below this, again, is the "spinal cord," with its pairs of branching nerves, sensory and motor (*i. e.*, nerves of sensation, and nerves of action) which largely control the activities of the body. In addition to this entire so-called "cerebro-spinal" system, there is also the "sympathetic" nervous system, which controls, very largely, the internal activities or functions of the various bodily organs—digestion, circulation, etc. By means of these mechanisms, which are interacting, and influence and control one another, the entire activites of the body are carried on in what appears to us an automatic manner, so that the mind is left entirely free to conduct, unhampered, the operations of consciousness.

Practically all the activities of the body are in this way regulated without our conscious intervention, and only conscious muscular activity calls for the exercise of directive thought. It is a beautiful and complicated system which brings home to us the degree to which the human body has evolved and perfected itself (or has been perfected) through countless centuries of gradual progress. It would almost seem as though the object of life had been to perfect a physical vehicle to such a degree that it no longer interfered with the operations of thought and consciousness, which could thus be carried on, in their own sphere of activity, quite independently of the body, and without being hampered or interfered with by the latter. Whether or not this view of the case has any ultimate significance will, of course, depend upon our outlook upon life, i. e., whether we consider that it has a spiritual "meaning" or not. The facts, at all events, might easily be interpreted in this manner.

HEREDITY

One of the most striking and characteristic manifestations of life is its power to reproduce itself, and to pass on to succeeding generations the bodily form and psychic peculiarities which that particular form of life possesses. This is known to us as Heredity. All life thus tends to reproduce itself, and, apart from slight variations, runs "true to type." Because of heredity, the characteristics of any given animal (say) is maintained, and it resembles its parents. Half its life characteristics are inherited

from each parent; one quarter from each grandparent; one eighth from each of its great-grandparents—and so on forever backwards into the generations of the past. Each one of us, therefore, represents a compound of all the generations which have preceded us. We are, so to say, a composite photograph resulting from all of them.

Very obviously, the body is thus subject to heredity; less obviously the mind. Prof. Ribot has, however, brought forward a mass of evidence, tending to show that mind is also subject to this immutable law, in his work on "Heredity." Environment and heredity are generally conceded to be the two great factors which go to the moulding of any individual.

Whether or not "acquired characteristics" are thus hereditary has been the subject of acute and prolonged controversy. Of late years, the tendency has been to disbelieve in such a possibility, but recent researches have again given plausibility to this idea, and there is a tendency among certain biologists to swing in favor of this belief.

How does heredity operate? It is now thought that there is a physical basis for heredity—this physical basis being the so-called "germ-plasm." This germ-plasm is composed of germ cells, and in each cell is a nucleus. Within this nucleus are tiny thread-like bodies, known as "chromosomes." These are the real carriers of heredity. There are a certain and definite number of these chromosomes (or idants), which vary in different animals and plants. These chromosomes, in turn, consist of "ids,"

each of which is thought to contain a complete inheritance. Each id consists of numerous primary constituents or "determinants." A determinant is usually a group of so-called "biophors,"—the minutest vital units known to us. The biophor in turn is an integrate of numerous chemical molecules.

It will thus be seen that the mechanism of heredity is an exceedingly complex phenomenon which is only what we should expect, in view of the complexity of life itself. The great puzzle is how all the potentialities of a living being can be crowded into the microscopic particles which form the physical basis of heredity. The character of the offspring depends (as J. Arthur Thompson points out, in his work on "Heredity"), upon the adjustments arrived at among the different sets of determinants of paternal and maternal origin.

There are those, however, who refuse to see, in these microscopic units more than the physical counterparts of life itself. It has been contended that life is something over and above matter, and that heredity is really carried in some super-physical realm, (a sort of "astral" heredity), and that the physical bearers of heredity known to us represent, merely, the physical *vehicles* for this life-energy—in much the same way that the human brain is the material instrument of thought and consciousness. Whether such a view of the case appears plausible will depend, of course, upon the view we take of the universe. If any super-physical realm be admitted, such a view is actually necessitated, while from the purely mechanistic

standpoint, such an idea would appear quite superfluous, if not absurd. This question, like so many others, will only be settled by the determination of the ultimate nature of life.

All life thus originales within a single, microscopic cell. Growth takes place by reason of continued cell-multiplication. This multiplication results from division (!); that is to say, the division of the mother cell into two daughter cells, which in turn sub-divide, and so on throughout the entire life of the organism.

When studied by means of high-powered microscopes, the cell is seen to contain within its plasm a nucleus, and within this a still smaller point, known as the "nucleolus." A so-called "attraction sphere" is also seen, consisting of two tiny points, which divide, descend to opposite sides of the nucleus, and send out lines of force, seemingly very similar to those observed at the ends of a magnet; and these lines of force arrange the thread-like chromosomes into parallel lines, which then divide lengthwise, and are drawn towards the tiny centers of force (centrosomes)—being there rearranged, to form the bases for two new cells. This process is known as "Mitosis" (or karyokinesis), and has been studied in great detail in its various phases. The reader may consult the elaborate work by Prof. E. B. Wilson, "The Cell," for details.

By means of this cell-division, therefore, cells multiply in number; they are built-up into tissues, into organs, into a complete human body. In the simpler forms of life, these various processes may be followed with com-

parative ease, but in more highly developed forms of life, the problem is correspondingly difficult. The task of passing-on life is then consigned to definite units of living matter, which are forever passed onward through succeeding generations, while the great mass of bodily matter is cast-off as of no further use, at death.

THE NATURE OF LIFE

Every animal and vegetable has its own particular *variety* of life. The life of a cabbage is entirely different from that of a fox-terrier, and this, in turn, is very different from the life of man. Cabbages tend to reproduce cabbages and fox-terriers, fox-terriers. It would appear, therefore, that there are as many varieties of life-energy, as there are plants, animals, insects, etc., in the entire world, and that these varieties of life-energy cannot interchange one with another, or vary from their original pattern to any great extent. All life may ultimately be *one*, but in its expression, it assumes many forms, aspects, or manifestations.

The life-energy of the human body was called its "vitality" by the older writers. They assumed that life was an energy different from all other energies in the world, and in no way related to them. This was the doctrine of "vitalism," which is still maintained by certain eminent biologists. Hans Driesch, Bergson, James, Minot, and others have ably defended the vitalistic theory, while the majority of physiologists are inclined to accept a mechanistic interpretation of life—contending that life is merely one of the modes or expressions of

energy, and as such subject to the law of conservation. We have already touched upon this question, briefly, in the chapter dealing with the origin of life.

There is undoubtedly an equivalence which can be roughly measured between the energy-content of food consumed, and the energy expended by the body in its various activities. The analogy usually employed is that of the steam engine. Here a certain amount of coal (fuel) is consumed, which supplies a certain amount of heat and energy during its combustion. Similarly, it is claimed, a certain amount of fuel (food) is supplied to the human body, and heat and energy are likewise imparted during the period of its oxidation and combustion.

This equivalence has been proved to exist in the human body by means of an instrument known as a "calorimeter." The living subject is inclosed within a small cabin-like space, and the heat and energy output of the body are accurately measured by means of delicate registering instruments, the amount of carbon dioxide, heat, etc., being thus determined.

The usually accepted view is that the latent energy of the food is imparted to the body, which expends it in various internal and external nervous and muscular activities. There is, however, an alternative theory, which may be advanced, and which has in fact been defended by the present writer and others, which, while it accepts the admitted facts of *equivalence*, contends that the relationship in question (between food and bodily energy) is not that of cause and effect, but *mere* equivalence.

The theory which I am inclined to defend is briefly the following: The human body does not resemble the steam engine as much as it does the electric motor, which at certain times is recharged by energy from without. During the hours of rest and sleep, the human body is similarly charged by some cosmic energy which flows into it at such times. This energy is merely expended in the various bodily and mental activities, but the source of the energy is not the food, which only supplies the body with a certain amount of heat and replaces broken-down tissue. The more tissue which is broken down, in work, the more must be replaced; consequently a greater amount of food must be consumed in order to repair this waste. There is, therefore, an equivalence; but this equivalence is not that of cause and effect. If the strings of a musical instrument were self-repairing, we might perhaps be inclined to think that the material which fed the strings was the cause of the music, since in that case some measure of the waste would probably be discoverable in the *debris* emitted; and we might imagine that the *debris* was the measure of the music, while what it really was was the measure of the waste of the strings when they were made the instrument of music. If a spade is used in digging, the spade wastes in proportion to every spadeful of earth it is made to lift. The more it digs, the more it wastes. If we could arrange that a stream of fine steel particles flowed into the spade, to replace the waste caused by each act of digging, we might perhaps come to think that these fine steel particles were the cause of the digging—especially

as the quantity of them required would always be exactly proportional to the amount of work done. Nevertheless, this would be a very inconsequent assumption. So it would be also if we were to infer, because the motors at the bottom of the electric tram-car waste as they are used by electric energy, as the means of doing work, and if we could arrange that this waste should be made good by some self-acting mechanism—as well might we imagine that the steel particles flowing in were the cause of the work done, as that the food is the cause of the work done by the human body. Yet this is the assumption invariably made by modern scientists.

In other words, food does not *cause* or *create* the bodily energy—any more than the steel particles cause the digging or the power contained within the electric motor. Food merely repairs the body—*through which* the energy flows; and the more work done, the greater the amount of food needed, to repair the loss. Hence the equivalence, but not the causation!

Are there any facts which tell in favor of this view, as opposed to that commonly held? There are several, among which I might mention the following:

(1) Whenever we become tired, as the result of the day's work, we must retire to the bedroom and not the dining room, in order to recover our strength and energy. No matter how much food we eat, how much exercise we take, how thoroughly we breathe, or how completely this food material may be oxidized, there always comes a time, nevertheless, when

we become tired and exhausted, and this exhaustion can only be relieved by rest and sleep—and not by adding more fuel, in the shape of food. *Sleep*, therefore, is a very peculiar condition, which differentiates the human body from any form of steam-engine known to us. It seems to show us that there *is* a great difference between the method by which the human body replenishes its energy, and the ordinary chemical combustion theory, which is applicable to the steam engine.

(2) Many persons, who have become weakened by the onset of some disease, will find that their energy is increased, by abstaining from food altogether, for a longer or shorter period—that is, by *fasting*. I have seen many cases in which the patient was so weak that he was hardly able to walk upstairs. Yet, after having abstained from all solid food for a number of days, he was enabled to walk several miles daily, and felt better and stronger than he had for years past! This is readily understood by students of therapeutic fasting, but, without going into the details now, it may be pointed out that such an increase of energy could hardly be expected, if the source of our bodily energy were the food we eat!

Other arguments might be advanced in support of this theory, but enough has been said, perhaps, to indicate that it is a legitimate interpretation of the observed facts, and that it is in accord with the findings of physiological science.

Professor Hans Driesch has advanced other views in favor of the vitalistic interpretation,

which are to be found in his "Science and Philosophy of the Organism," (2 vols.), and in his "History and Theory of Vitalism." Those who are interested in the subject may find an exposition of the theory in these works, as well as in my own book "Vitality, Fasting, and Nutrition." A good statement of the mechanistic view, on the other hand, may be found in such works as Jacques Loeb's "The Dynamics of Living Matter," "The Mechanistic Conception of Life," and Professor Osborne's "Origin and Evolution of Life."

Whatever view we may take of the nature of life, however, it is certain that of its *essence* little or nothing is known. We know life merely by its *expressions* or *manifestations;* but of the invisible Principle itself, lying behind, and governing and controlling these manifestations, we know but little. It remains for the science of the future to determine if possible, the precise nature of life.

THE VEHICLE OF MIND

We are so accustomed to think of mind as being intimately connected with the brain and the nervous system that it is almost a shock when we realize that this conception is relatively *new*, and that, until the past two or three hundred years, physiologists thought that mind had its physical basis or seat in various other bodily organs—the heart, the spleen, etc. Nowadays, the location of the various motor and sensory activities of the mental life has been carried to such a fine point that it is possible to place a finger upon a certain spot or area

in the brain, and say "*here* occurs the sensation of sight," or "this portion of the brain is responsible for the movement of the toes on the left foot," etc. Sensory or afferent nervous impulses carry sensations from the surface of the body to certain centers, and here a change of some sort takes place, which occupies an appreciable time, and which is analagous to conscious deliberation on the part of that nerve center, as though deciding what to do. A motor or efferent nervous impulse is then sent forth, causing a specific movement, representing a reaction to the stimulus in question.

What is the nature of this nervous impulse? The general structure of the nervous system being so similar to an electric relay system, it has been contended, very naturally, that the nature of the nervous impulse is electric in character. This idea, however, was afterward shown to be untrue for the simple reason that the rate of conduction was so very different. A nervous impulse travels along the fibre with a velocity of only about two hundred feet per second, while the velocity of light and electricity, as we know, is slightly more than a hundred and eighty-six thousand miles per second. The two are, therefore, entirely dissimilar in character. If an elephant were to step upon a sharp object, it would take him an appreciable time to react, and lift his foot, whereas if the nervous current were electric in nature, this reaction ought to be practically instantaneous.

Dr. Max Mayer, in his book "The Funda-

mental Laws of Human Behavior" has this to say, regarding the nature of the nervous impulse:

"It is highly probable that the conduction of the excitation is a process of a chemical nature. The substance of a neuron, consisting of highly unstable organic compounds, must be well adapted to the conduction of chemical changes. It is also well-known that the conduction of chemical changes frequently involves, as by-products, so to speak, electrical phenomena. .....What happens is this: A stream of elementary substance flows—or, whatever it may actually do, is imagined to flow—from one end of the conductor to the other, and this flow or wandering of molecules or "ions," as it is usually called, is accompanied by an electrical phenomenon. We are, then, probably justified in regarding the conduction of an excitation through a neuron as, not identical with, but at least analogous to, the wandering of ions through a conducting fluid—the electrolyte, to use the technical term—of a storage battery."

The fact that the nervous current is probably chemical in nature does not, however, help us to understand the nature of the changes which occur within the various nerve-cells of the body, —since these changes are, apparently, rational or teleological in their action. Especially we are no nearer an interpretation of the nature of the activities going on within the cerebrum, with which thought and consciousness are undoubtedly associated. The structure of the human brain is incredibly complicated, and the number of inter-acting nerve cells is indeed extraor-

dinary. Professor E. B. Thorndyke, in his "Elements of Psychology," (p. 151) says:

"It would take a model as large at St. Paul's Cathedral to make all the neurons in the brain visible. A man counting at the rate of fifty a minute, working twelve hours a day, would take probably over seven-hundred years to count all the nerve cells in one man." There are well over ten-thousand million of them in the body.

Such, then, is the complicated nature of the nervous mechanism upon which life depends, and which is the basis for the manifestation of life and mind. Our nervous system, even more than any other portion of the human anatomy, has been slowly perfected through countless ages of evolution, and the comparative growth of the nervous system has now been clearly traced. Life and mind on the one hand, and the nervous system on the other, have somehow evolved together; but whether life and mind have become more complicated and expansive as the nervous system has evolved (materialism), or whether the nervous system has become more complex because of the constant urge of higher forms of life-energy, tending to manifest through it (idealism)—this is, as yet, an unsolved question, which only an ultimate interpretation of the nature of things can decide. A further discussion of this question undertaken in the chapter dealing with life and mind.

LIFE AND MIND

In the year 1886, a little book was published entitled "Can Matter Think?" Considerable

discussion was stimulated at the time by the publication of this book, and others of a similar character, dealing with the relationship between mind and matter.

There can be no doubt that the majority of the bodily activities can be accounted for on purely physical and chemical lines, and there are many scientists today who contend that *every* activity of the body can thus be accounted for. The body and its activities are regarded as a physico-chemical mechanism. On this view, the activities of mind and consciousness are the products of brain-action, in the same way that other activities of the body result from the functioning of certain specific organs and *their* activities. This is the materialistic conception.

The body is certainly composed of matter and energy. Is there anything further? Huxley, in one of his celebrated Essays, said that it was obvious to him that there *was* some "third thing"—namely, consciousness. Is this "third thing" altogether separate from the other two, or is it merely a resultant of special nervous energies?

This question of the inter-relationship of matter, life, and mind is an extremely interesting one. All energy, in itself, is more or less *blind* in its action, but when it is acting toward a specific end, it seems that a certain amount of "direction" is necessarily called into play. Sir Oliver Lodge has contended that the important and distinguishing characteristic of life is its ability thus to govern or direct energy—which in turn controls matter. He contends

that life is not in itself a special energy, but that it is merely *that which* directs or controls it. It is, however, difficult to see how anything which is not in itself energy, can control or direct some other energy. It would appear just as difficult for an abstract thought to affect a flowing energy, as it would be for (say) the idea of a beefsteak to couple-together two pullman cars!

Certainly the *matter* of the brain cannot in itself "think." There is no more reason why a certain specific nervous structure should give rise to active consciousness, than that any other complex living material should do so. The question is: Does consciousness somehow *arise* from the flow of the nervous currents within the brain? Materialistic science says that the activities of the mind are somehow synonymous with these nervous currents. Yet there are other nervous currents traveling about all over the body, which do not give rise to self-consciousness. Why is it that they should do so in the special organ of thought, known as the brain?

It must be remembered that *mind* is not the same thing as *life*. Parts of a body may be alive, while other parts of it are dead. After a chicken's head has been chopped off, it often gets up and runs about for a half-a-minute or more, and will even show certain signs of active direction of the body, and will pick itself up if it stumbles over an object, etc. It is well-known, also, that after the conscious life of an organism has ceased, its bodily life continues for some time. This is the so-called

"somatic" life of the organism; and various tissues and organs die at different rates. The life of the body, therefore, is not the same thing as its conscious self-existence.

Let us lead up to our main problem in another manner. The principle of the conservation of energy says that all force or energy can be converted into other energy, and that nothing is lost during this process of transformation. Heat may be converted into light, chemical energy into heat, etc. All energies are thus transmuted, one into another, and it has been contended that life is only one special *kind* of energy, which results from the transformation of chemical, thermal, and other energies. The energy of the body is said to be derived more or less directly from the combustion of fuel (food) taken into it, and converted, in the body, into living bodily substance, heat, and energy. This energy is *life-energy*. Part of this life energy is expended in muscular activities, part of it in running the internal mechanism of the body, and part of it in nervous activities. Of these nervous activities one particular variety is that expended in the processes of thought. On this view, thought is said to be a particular type or kind of nervous energy, derived from other energies, and in turn capable of being transmuted or re-transformed into them.

This view has been defended with considerable ingenuity by Professor Ostwald, and others, and, so far as it goes, nothing can be said against it. The only question is: Does such

a view of the case go far enough? Does it actually explain the facts of consciousness?

The important factor about consciousness is that it has, for us, a particular significance or *meaning*. Can "meaning" be accounted for on the theory that mental activities are nothing more than specific nervous currents? Professor William McDougall, in his work "Body and Mind," has contended that meaning cannot be thus accounted for. It is something over and above the physical content, so to say, of the specific nervous current involved. The "meaning" of a thought, he contends, cannot be accounted for on purely physico-chemical terms. And, judging from certain obvious analogies, this is in fact the case.

Thus, if you were to receive two telegrams, one of which read "Our son is dead," and the second "Your son is dead", the thoughts and emotions aroused in consequence would be of an entirely different character. Yet there is only one letter (y) different in these two messages. The physical stimulus on the brain resultant from reading both telegrams must be very nearly identical. Yet the internal results are very dissimilar. These internal results are due to the fact that the significance or "meaning" of the message, to the living consciousness is so very different, yet the physical stimuli, in the two cases, are almost identical.

This example brings home to us the great importance of the inner meaning of thought. When we read the printed page of a book, we do not only receive certain nervous impulses, resulting in turn from light-waves striking the

eye; we get in touch with the thought and spirit of the author. The printed letters are mere symbols. It is very difficult, therefore, fully to account for the activities of consciousness on any purely materialistic view. If matter cannot think, and energy cannot think, what is it that thinks,—since thoughts certainly exist, and are (for us) the most important factors in the Universe?

Yet it is certainly true that mind and brain are somehow related. We know that we can mix poison in a man's blood, and his thinking facilities become impaired. On the contrary, a man may read a telegram and drop dead,—seeming to show the enormous influence upon the body of the mind and the emotions, Some sort of relationship or interaction must therefore exist between them. What is the nature of this relationship? How can mind and body be conceived of as influencing one another?

This is one of the most interesting of all metaphysical questions—the relationship of mind and body. Various theories have been advanced in the past in an attempt to account for this relationship. The purely materialistic conception (that nothing but matter and energy exists) has now been entirely given up, since it fails to take into account the very obvious reality of consciousness.

Huxley attempted to account for consciousness by assuming that it somehow followed along with, or resulted from, certain specific brain activities, and that, just as the shadow of a horse accompanies the horse, so thoughts and mental activities of all kinds accompany

the nervous currents, which play to-and-fro in the higher centres of the cerebral cortex. He coined the term "Epiphenomenon" to express or signify this by-product, so to say, of brain activity. The difficulty with this theory is that, for us, the important thing is the shadow and not the horse! And it is also difficult to explain why such a mere by-product should ever have come into being in the process of evolution. Furthermore, the specific character of the relationship between these two (mind and brain) is not in the least explained by this formula. It merely states the facts. The primary question still remains: How can a particular thought (apparently a non-material thing) and a particular brain-change (a material thing) be related one to another?

Professor Tyndall saw this difficulty very clearly, and, in his "Fragments of Science" stated the problem thus:

"The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently, any rudiment of the organ, which will enable us to pass, by a process of reasoning, from the one to the other. Were our minds and senses so expanded, strengthened and illuminated as to enable us to see and feel the very molecules of the brain; were we capable of following all their motions, all their groupings, all their electrical discharges, if there be such; and were we intimately acquainted with the corresponding

changes of thought and feeling, we should probably be as far as ever from the solution of the problem: How are these physical processes connected with the facts of consciousness? The chasm between the two classes of phenomena would still remain intellectually impassable."

Seeing that such enormous difficulties existed, then, in the attempt to account for consciousness in this manner, other theories were brought forward by way of explanation. Among these, we may briefly mention the following:-

PSYCHO-PHYSICAL PARALLELISM: This is the doctrine which was defended by Professor Munsterberg and others. It contends that brain changes and states of consciousness are merely coincidental in point of time, and do not ever influence each other. Their relation is that of coincidence or concomitance, and not causation. The two flow along, side by side, without in any way interfering with one another.

As regards this doctrine, it need only be pointed out that, were it true, mind and body could never influence one another, since they are not causally connected. Yet, if there be no connection, how is it that they correspond so exactly?—for, as William James said, "It is quite inconceivable that consciousness should have *nothing to do with* a business which it so faithfully attends."

PHENOMENALISTIC PARALLELISM: This is the theory maintained by Kant, Spinoza, and others. It maintains that both brain and consciousness (or mind and body) are but two different expressions of one underlying reality

—just as the convex and concave surfaces of a sphere are but two expressions of an underlying reality. As to the nature of this reality, Kant and Herbert Spencer were content to call it X, or the unknown, while Spinoza maintained that it was God.

Analogies which are held to support this doctrine are, however, extremely defective; but the subject is too lengthy and technical to elucidate in detail here.

PSYCHICAL MONISM: This doctrine contends that consciousness is the only reality—the material world being external appearance only. Thoughts are causally connected, but not necessarily physical events. (This doctrine is thus the exact inverse of epiphenomenalism.)

In refutation of this theory, it may be pointed out that, if brain changes are thus caused by, or are the outer expression of, thought,—why not muscular changes, and in fact *all* physical phenomena throughout the world everywhere:—for we cannot rationally draw the line of distinction here. Such is the logical outcome of the theory—and has in fact been accepted in this form by Fechner and others.

While many philosophers are inclined to accept this view, it may be stated that the physical scientists are naturally repelled by it, and so is common sense.

SOLIPSISM: The contention of this theory is that nothing exists save states of consciousness in the individual. Neither the material world nor other minds exist (save in the mind of the individual). This doctrine is so opposed

to common sense and daily experience that it is unnecessary to dwell upon it.

INTERACTIONISM: (Animism) Here we have the world-old notion of mind or soul, and body, existing as separate entities, influencing each other. Mind is here supposed to influence matter, and utilize it for the purposes of its manifestation. Were such a theory true, it would of course enable us to accept not only the reality of psychic phenomena but the persistence of individual human consciousness after death. The main objection to this doctrine is that it postulates a form of *dualism*, which is very obnoxious to many minds! It is possible, however, that such a doctrine may one day be forced upon us by the gradually increasing evidence furnished us by psychical research.

Professor William James, in his little book on "Human Immortality," while admitting the undoubted fact that brain and mind are in some way related one to another, disputed the idea that the nature of this connection was necessarily *causal*. He contended that it is quite possible to assume or believe that the functions of the brain are "transmissive," and that they merely *transmit* or express the flow-of-thought, which constitutes consciousness. This view was subsequently worked-out in considerable detail by Professor F. C. S. Schiller, and to some extent by Bergson. On this view, the undoubted fact of the connection between brain and mind can be accepted, without necessarily accepting, at the same time, the ordinary

materialistic explanation which is usually assumed in consequence.

Summarizing this chapter, it may be said that one of the most unique characteristics of life, and particularly of the higher forms of life, is its ability to express more or less complicated mental activity, resulting in self-consciousness in man. Thoughts do not arise from matter or from energy. They represent some third form of existence, and activity, differing from these two. Consciousness is the highest manifestation of life, but as to its origin, destiny, and the nature of its connection with the physical body and brain—these are as yet unsolved metaphysical questions, the answer to which can only be found by continued research in the direction of higher physical and psychical science.

LIFE AND DEATH

In one sense, it is true that all life has a beginning, in another sense, it is not! Each *individual* life apparently begins at the moment of conception, and ends at death; yet life itself reaches back into the dim past, and of its origin nothing certain is known (as we have seen in the chapter dealing with the origin of life.) We can only think of the ultimate termination of all life with the end of the world—or at least its habitability; yet each individual life, as we have said, terminates at death; and if any form of life exists after death, that can be proved only by psychical research. Paradoxically, life is infinitely finite—and ceaselessly ceasing!

Moreover, it is often most difficult to decide just *when* life ends and death begins. The recent experiments of Prof. Osterhout have shown us that a living thing may be fifty per cent alive, and fifty per cent dead, or seventy per cent dead and thirty per cent alive, etc. Up to a certain point, revivification may take place; beyond that limit, life can no longer be made to return. This discovery—that life and death imperceptibly shade into each other—is a very significant one, which gives us much food for reflection; for at what point is death inevitable, and when may not life be revived, if only we know the secret *how?*

I once saw a very striking experiment, which illustrated this in rather a dramatic manner. Two living eels were dropped into liquir air; that were instantaneously frozen into steel-like rigidity. They were then removed from the bottom of the jar by means of pincers (they had frozen to the bottom) and both held in the air. "Now," said the Professor, "which eel shall I drop—the right or the left?" A choice having been made, the eel was dropped, and broke into a thousand fragments on the stone floor—as though it were made of glass. The other eel was replaced in the original jar of water, and, in a few minutes, was swimming about as contentedly as though nothing had happened to it!

Suppose we had chosen the other eel? Where was the "life" of the restored one during the period when it was frozen? Assuredly it was "dead"—as dead as ever it will be—and yet it was restored to life again! To what extent

is it thus possible to restore life to a living thing, once it has been pronounced dead? Surely, life and death are but relative terms, and the two glide into one another by imperceptible degrees. Yet there is all the difference in the world between a living creature and a dead one!

Prof. Chunder Bose has proved that a certain "spasm" occurs at the moment of death, accompanied by one of an electrical nature, in certain plants studied by him. He says:

"A time comes when, after an answer to a supreme shock, there is a sudden end of the plant's power to give any further response. This supreme shock is the shock of death. Even in this crisis, there is no immediate change in the placid appearance of the plant. Drooping and withering are events which occur long after death itself. How does the plant, then, give this last answer? In man, at the critical moment, a spasm passes through the whole body, and similarly in the plant I find that a great contractile spasm takes place. This is accompanied by an electrical spasm also. In the script of the death recorder the line, that up to this point was being drawn, becomes suddenly reversed, and then ends. This is the last answer of the plant.

"These, our mute companions, silently growing beside our door, have now told us the tale of their life-tremulousness and their death-spasm in script that is as inarticulate as they. May it not be said that this, their story, has a pathos of its own beyond any that we have conceived?" (Lecture before the Royal Institution of Great Britain, May 29, 1914.)

Prof. Shiro Tashiro, of the University of Chicago, has shown that all living things give off carbon dioxide—even seeds which have been almost completely desiccated, and are many years old. As long as this gas is given off, the plant or animal is alive; but as soon as it is dead, this ceases. He has proposed in this experiment a new test for death—or for life! He is careful to point out, however, that this is merely a chemical sign, which is the result of life activities, and in no wise helps us to understand the nature of life itself. It is merely one of its phenomena or manifestations.

The extraordinary difficulty which we experience in telling when a thing is alive and when it is dead is also illustrated by experiments conducted at the Rockefeller Institute, in New York, in which a fragment of a chicken's heart has been kept alive for several years,— and is even *yet* healthy and growing actively! For a number of days, this fragment of heart pulsated; these pulsations gradually ceased, but the fragment continued to live and grow. Certain salt-solutions, in which the tissue was immersed, rendered this possible. Here is a very extraordinary fact, and has naturally given rise to much speculation as to the role which certain solutions of salts may play in the human economy. Loeb and others have written extensively upon this subject.

The recent experiments in "grafting glands," and thereby effecting a certain apparent rejuvenation in the subject, are also thought-provoking; for to what extent are health and youth dependent upon the secretions of these glands?

These are all questions which are discussed at greater length, however, in the volume in this series dealing with the problem of death. That and the present book may, perhaps, be regarded as more or less companion volumes.

LIFE'S MEANING AND DESTINY

If the origin of life is a great, unsolved problem, so also is the question of its destiny! What is the meaning of life! Why are we here? Why should animate being exist at all? Why should the Universe be in existence? Why should all this ever have emerged from a hypothetical original state of Nothingness? These are questions which are bound to attract the attention of all thinking minds, at one time or another, and call loudly for solution.

Many answers to this world-old riddle have been attempted, two of which represent precisely opposite and contrary views. These are (1) the *mechanistic* conception; Life has *no* meaning; it is absurd, illogical, futile. Ultimate extinction is the lot of all; final resolution into dead matter and blind energy. (2) The *Theological* conception: Everything has a hidden, yet beautiful, meaning; the soul is immortal, and will ascend to Heaven after passing through this Vale of Tears; "God is in his Heaven, and all's well," etc. These two extreme views—the antitheses of each other—are both probably equally far from the truth. A rational interpretation of things must lie somewhere between them.

We have seen that life is, within its own sphere, certainly purposeful or "teleological." Life works for its own prolongation, perpetua-

tion and betterment. Ever since the appearance of life upon our planet, it has been increasing in power and complexity; mind has been rising higher and ever higher in the scale. To what end? If all is to end in nothingness, it is a senseless world indeed!

Newton's first law of motion tells us that a body will remain forever at rest unless some force acts upon it, and sets it in motion; but that, when once in motion, it will continue moving indefinitely, provided no other energy acts upon it, and nothing stops it. The movement goes on forever as it is. There is no change. (Note that.) But, in the evolution of life, we certainly find change; it is progressing, becoming more and more complex. Yet, if life were a mere blind force, this should not be so; there should be no alteration and no improvement. Some factor or energy is at work, therefore, causing this change and improvement—either an external agency, or some inner, invisible power of life.

We have seen that life must have become manifest on this physical plane at some definite time in the past; it must discontinue its activities at some definite time in the future. All progress, all evolution, must take place between these extreme points. Our world certainly came into being at some time in the past, and will as certainly die a natural death at some distant date in the future. This intervening period may be many thousands of millions of years; but what is that compared to eternity?

At some time in the past, then, life came into being—or, on any theory, commenced its *active*

manifestation. Higher and higher forms of life appeared, as the result of gradual evolution. Finally, man appeared. Is he the final product? Does he represent the final link in the chain of evolution? One can hardly think so! It may be humiliating to our pride, but there are many philosophers, as we know, who contend that a superior race will come into being, having a type of mentality relatively as superior to man's, as man's is superior to (say) a dog's. There will be the "Supermen," possessing superconsciousness. What may follow this step in evolution is still more problematical.

Why are we here? Why does life manifest itself at all? Doubtless the most obvious reply to this question is that it is the innate quality or property of living matter thus to express and perpetuate itself. The desire for expression is universal—to live, to create. It is second only to self-preservation. Yet, if mere perpetuation were the object, and nothing more, what a futile world it would be! Many of the lower forms of life die immediately they have procreated (*i. e.*, the males), while the females lay their eggs, which are hatched out into similar living creatures, which in turn go through the same process and so on *ad infinitum* and *ad nauseam*. To what end? If there is no evolution, no meaning and no finality to life, it would indeed be a curious world in which we live!

If life has any meaning, it must be a *psychological* meaning; we have already seen the gradual perfection of the body, and the expansion of the living consciousness, during countless ages of evolution. Is the object of being to perfect

a high spiritual consciousness in man? That might be a rational view of the facts, provided there were some object in view in thus perfecting it. Perfecting a thing merely to destroy it does not show good common-sense. Is there an ultimate destiny and utility for consciousness? If there be some form of permanence for that consciousness—yes! If there be none, it is hard to see the reason for its evolution and perfection.

How can we assure ourselves of its permanence? Only by obtaining scientific *proofs* of it, and these proofts can come to us only in one way. By obtaining specific *facts*, proving that consciousness still exists. And this proof can come only by means of psychical research! For, apart from such evidence, there is none other; monism or some form of modified materialism would be in possession of the field. Rightly understood and interpreted, therefore, psychical phenomena are not merely vain pryings into trivial and silly manifestations, but an interpretation of facts upon which a whole cosmic philosophy may be built—an interpretation of the universe, which is not possible in their absence. Such a proof of the higher powers of mind and spirit, and its permanence and value, would alone permit us to form some rational and systematic interpretation of the Universe.

Yet, if this were true, it may be asked: "Why have a physical body at all? Why not persist in some spiritual world from the beginning to the end of things, without bothering with this entangling mass of matter at all?" Fitz Hugh Ludlow, in his remarkable book, "The Hasheesh

Eater" has proposed an answer to this puzzling question. He says:

"That spirit should ever lose the traces of a single impression is impossible. DeQuincy's comparison of it to the Palimpsest manuscripts, which is one of the most powerful that even that great genius could have conceived, is not at all too much so to express the truth. We pass, in dreamy musing, through a grassy field; a blade of the tender herbage brushes against the foot; its impression hardly comes into consciousness; on earth it is never remembered again. But not even that slight sensation is utterly lost. The pressure of the body dulls the soul to its perception, other external influences supplant it; but when the time of the final awakening comes, the resurrection of the soul from its charnel in the body, the analytic finger of inevitable light shall search out that old inscription, and to the spiritual eye no deep graven record of its earthly triumphs shall be clearer.

"The benumbing influences of the body protect us here from much of remorse and retrospective pining. Its weight lies heavily upon the inner sense, and deadens it to perception of multitudes of characters which, to be read, require acutest powers of discernment. When the body is removed, the barrier of the Past goes also.

"This fact may perhaps be one of the final causes, why the body exists at all. Why are we not born directly into the spiritual world, without having to pass through a weary preliminary experience, hemmed in by the gross corporeal

nature? May not the answer be something like this? Were the soul, at its first creation, introduced directly into the world where truth is an intuition, and stand in the dazzling light of its own essence, the dreadful sublimity of the view might prove its annihilation. We accordingly pass first through an apprenticeship, in which we have nothing colossal either to learn or to do; and eternal verities dawn on us slowly, instead of breaking in like lightning. . . . Without this slow indoctrination, the soul might have flamed out in dazzling momentary irradiance, and then been extinguished in eternal nothingness. . . .".

That all this is purely speculative, we must admit. Such a view was, perhaps, influenced to some extent by the author's own experiments, in which he felt assured of the severance of his "soul" from his body, under the influence of hasheesh. Yet, such drugs have often been the means of remarkable interior illumination, and great flights of philosophical speculation—witness Paul Blood's remarkable pamphlet, "An Anaesthetic Revelation," summarized by William James, in his "Memories and Studies." Perhaps Truth may be glimpsed at such times, more truly than in our ordinary, wake-a-day world.

And the whole physical Universe? What is the meaning of that? Western science has no answer. It says: Let us take things as we find them, without seeking for ultimate causes. Oriental philosophy, on the other hand, has concerned itself greatly with such metaphysical speculations. Their belief is that this entire

physical universe of ours is moving in a sort of cycle; it becomes active, dynamic, expresses itself in form and life, and then gradually becomes formless, inactive, static,—in which condition it remains for a certain period of time before it again becomes manifest—and so on, forever, perpetually expressing itself in a series of cyclic activities. Whether such an idea represents anything like the truth we have, of course, no means of knowing—or rather, of proving scientifically.

At all events, Life has a meaning and a purpose in and for itself. It strives, it perfects, it manifests. Whether this constant effort on the part of life has any ultimate, cosmic significance must depend upon the destiny of life itself. Our interpretation of the meaning and significance of life will thus depend upon the view we take of the nature of the Cosmos; and the nature and significance of this will, in turn, depend partly upon insight and philosophy, and partly upon scientific researches,—which are thus destined to serve as torches to illumine the road which we must ultimately travel.

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